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# CANCER FACTS

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National Cancer Institute • National Institutes of Health

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## Lasers in Cancer Treatment

Laser therapy involves the use of high-intensity light to destroy cancer cells. This technique is often used to relieve symptoms of cancer such as bleeding or obstruction, especially when the cancer cannot be cured by other treatments. It may also be used to treat cancer by shrinking or destroying tumors.

### What Is Laser Light?

The term "laser" stands for light amplification by stimulated emission of radiation. Ordinary light, such as that from a light bulb, has many wavelengths and spreads in all directions. Laser light, on the other hand, has a specific wavelength and is focused in a narrow beam. This type of high-intensity light contains a lot of energy. Lasers are very powerful and may be used to cut through steel or to shape diamonds. Lasers also can be used for very precise surgical work, such as repairing a damaged retina in the eye or cutting through tissue (in place of a scalpel).

### Types of Lasers

Although there are several different kinds of lasers, only three kinds have gained wide use in medicine:

- **Carbon dioxide (CO<sub>2</sub>) laser**—This type of laser can remove thin layers from the skin's surface without penetrating the deeper layers. This technique is particularly useful in treating tumors that have not spread deep into the skin and certain precancerous conditions. As an alternative to traditional scalpel surgery, the CO<sub>2</sub> laser is also able to cut the skin. The laser is used in this way to remove skin cancers.
- **Neodymium:yttrium-aluminum-garnet (Nd:YAG) laser**—Light from this laser can penetrate deeper into tissue than light from the other types of lasers, and it can cause blood to clot quickly. It can be carried through optical fibers to less accessible parts of the body. This type of laser is sometimes used to treat throat cancers.
- **Argon laser**—This laser can pass through only superficial layers of tissue and is therefore useful in dermatology and in eye surgery. It also is used with light-sensitive dyes to treat tumors in a procedure known as photodynamic therapy (PDT).

### Advantages and Disadvantages of Laser Use in Medicine

Lasers have several advantages over standard surgical tools:

- Lasers are more precise than scalpels. Tissue near an incision is protected, since there is little contact with surrounding skin or other tissue.
- The heat produced by lasers sterilizes the surgery site, thus reducing the risk of infection.
- Less operating time may be needed because the precision of the laser allows for a smaller incision.
- Healing time is often shortened; since laser heat seals blood vessels, there is less bleeding, swelling, or scarring.
- Laser surgery may be less complicated. For example, with fiber optics, laser light can be directed to parts of the body without making a large incision.
- More procedures may be done on an outpatient basis.

There are also disadvantages with laser surgery:

- Relatively few surgeons are trained in laser use.
- Laser equipment is expensive and bulky compared with the usual surgical tools, such as scalpels.

- Strict safety precautions must be observed in the operating room. (For example, the surgical team and the patient must use eye protection.)

## **Treating Cancer With Lasers**

Lasers can be used in two ways to treat cancer: by shrinking or destroying a tumor with heat, or by activating a chemical—known as a photosensitizing agent—that destroys cancer cells. In PDT, a photosensitizing agent is retained in cancer cells and can be stimulated by light to cause a reaction that kills cancer cells.

CO<sub>2</sub> and Nd:YAG lasers are used to shrink or destroy tumors. They may be used with endoscopes, tubes that allow physicians to see into certain areas of the body, such as the bladder. The light from some lasers can be transmitted through a flexible endoscope fitted with fiber optics. This allows physicians to see and work in parts of the body that could not otherwise be reached except by surgery and therefore allows very precise aiming of the laser beam. Lasers also may be used with low-power microscopes, giving the doctor a clear view of the site being treated. Used with other instruments, laser systems can produce a cutting area as small as 200 microns in diameter—less than the width of a very fine thread.

Lasers are used to treat many types of cancer. Laser surgery is a standard treatment for certain stages of glottis (vocal cord), cervical, skin, lung, vaginal, vulvar, and penile cancers.

In addition to its use to destroy the cancer, laser surgery is also used to help relieve symptoms caused by cancer (palliative care). For example, lasers may be used to shrink or destroy a tumor that is blocking a patient's trachea (windpipe), making it easier to breathe. It is also sometimes used for palliation in colorectal and anal cancer.

### *Laser-Induced Interstitial Thermotherapy*

Laser-induced interstitial thermotherapy (LITT) is one of the most recent developments in laser therapy. LITT uses the same idea as a cancer treatment called hyperthermia; that heat may help shrink tumors by damaging cells or depriving them of substances they need to live. In this treatment, lasers are directed to interstitial areas (areas between organs) in the body. The laser light then raises the temperature of the tumor, which damages or destroys cancer cells.

### *Photodynamic Therapy*

Photodynamic therapy (PDT) is based on the discovery that certain chemicals can kill one-celled organisms in the presence of light. Recent interest in photosensitizing agents stems from research showing that some of these substances have a tendency to collect in cancer cells.

The photosensitizing agent injected into the body is absorbed by all cells. The agent remains in or around tumor cells for a longer time than it does in normal tissue. When treated cancer cells are exposed to red light from a laser, the light is absorbed by the photosensitizing agent. This light absorption causes a chemical reaction that destroys the tumor cells. Light exposure must be carefully timed to coincide with the period when most of the agent has left healthy cells but still remains in cancer cells. There are several promising features of PDT: (1) Cancer cells can be selectively destroyed while most normal cells are spared, (2) the damaging effect of the photosensitizing agent occurs only when the substance is exposed to light, and (3) the side effects are relatively mild.

A disadvantage of PDT is that argon laser light cannot pass through more than 3 centimeters of tissue (a little more than one and an eighth inch). PDT is mainly used to treat tumors on or just under the skin, or on the lining of internal organs. It can be used in the

treatment of skin cancers just under the skin; or it can be directed through a bronchoscope into the lungs, through an endoscope into the esophagus and gastrointestinal tract, or through a cystoscope into the bladder. The National Cancer Institute and other institutions are supporting clinical trials (research studies) to evaluate the use of photodynamic therapy for other cancers. Researchers are also looking at different laser types and new photosensitizers that may increase the effectiveness of PDT against cancers that are located further below the skin or inside an organ.

### **The Outlook for Lasers in Cancer Treatment**

Doctors are trying to find new and better ways to use lasers in cancer surgery. As more cancer surgeons become trained in laser use and the technology improves, lasers may make increasing contributions to cancer treatment. Doctors are currently studying the effects of lasers in treating breast, esophageal, skin, colon, lung, brain, vulva, vaginal, cervical, and head and neck cancers.

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### **Sources of National Cancer Institute Information**

#### **Cancer Information Service**

Toll-free: 1-800-4-CANCER (1-800-422-6237)

TTY (for deaf and hard of hearing callers): 1-800-332-8615

#### **NCI Online**

##### ***Internet***

Use <http://www.cancer.gov> to reach NCI's Web site.

##### ***CancerMail Service***

To obtain a contents list, send e-mail to [cancermail@icicc.nci.nih.gov](mailto:cancermail@icicc.nci.nih.gov) with the word "help" in the body of the message.

**CancerFax®** fax on demand service

Dial 301-402-5874 and listen to recorded instructions.

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